

MEDDELELSER OM GRØNLAND

UDGIVNE AF

KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND

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DEN BOTANISKE EKSPEDITION TIL VESTGRØNLAND 1946

THE BOTANICAL EXPEDITION
TO WEST GREENLAND 1946

INTRODUCTION WITH A SHORT
MENTION OF THE VEGETATION AREAS EXAMINED

BY

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WITH 13 FIGURES IN THE TEXT

KØBENHAVN

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BIANCO LUNOS BOGTRYKKERI

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1. The Plan of the Expedition and its Practical Accomplishment.

During my studies of the flora of Greenland, and particularly the distribution of the species (BÖCHER 1938), it became clear to me that an examination of the interior of West Greenland behind the Colony of Holsteinsborg was urgently required. Numerous maps of distribution showed that the region was almost quite unexplored from a botanical point of view. A few botanical collections existed; some made by J. A. D. JENSEN in 1884 (cf. LANGE 1886) as well as a few more recent ones by O. HAGERUP 1925 and ERLANSON 1927 (cf. ERLANSON 1941). No thorough-going descriptions of the vegetation from the region existed, and cryptogam-collections were almost completely lacking.

It was, however, not only the shortage of material from the region behind Holsteinsborg that supported the desire for an expedition to the said regions. Of far greater importance were the phytogeographic conditions of the region. The investigations mentioned of the distribution of plants seemed strongly to indicate that the region in question must be intersected by several important phytogeographical borders. The Greenland alder, *Alnus crispa*, seemed to have its northern limit immediately south of the region, and a series of northern species appeared to have their southern limits in the region or its vicinity. Further one had in the interior of the country to reckon with rather extreme climatic conditions. J. A. D. JENSEN's descriptions (1884—85) of a salt lake and his collections of several species with continental distribution pointed in the direction of an arctic or subarctic steppe-region. The fact that he, who himself was not a botanist, collected several very rare species might seem to indicate that a rather peculiar flora existed at the margin of the ice cap.

In 1939 the planning of an expedition to Söndre Strömfjord was begun; it was one of the longest fjords in West Greenland, in all about 180 km. long. Its mouth is at 66° n lat. and its head very close to 67° n lat. exactly at the same latitude as the colony Holsteinsborg at the coast. The war prevented the realization of the plan, but in 1946 it was carried through.

During the war U.S.A. had built a large airbase at the head of Söndre Strömfjord. It was therefore natural that the expedition endeavoured to use it as their main centre. An application was accordingly sent to the State Department at Washington, and a favourable answer was received. The Expedition might count on getting a house placed at their disposal within the airbase, but would themselves have to look after their board during the stay at the base.

The following funds and institutions made it possible to carry through the Expedition:

The Carlsberg Foundation paid most of the equipment of the Expedition and all its other expenses.

The Danish Navy carried the Expedition free of charge to and from the head of Söndre Strömfjord and gave the Expedition an opportunity of examining some localities at the mouth and about midway in the fjord.

The Botanical Museum and Laboratory of the University of Copenhagen supplied the Expedition with plant-presses, glass and cases for the collections and lent us three thermographs and two microscopes, various smaller instruments, chemicals and the like.

The Geodetic Institute had fair drawings made of maps of the area not yet completed and furnished the Expedition with a set of air photographs of their working field.

The Administration of Greenland supported the Expedition in many ways, among other things by carrying the main part of the stores free of charge.

The Ivigtut Cryolite Mining Company provided room and board for the expedition during the three weeks on the way home.

The Expedition owes great thanks to the Carlsberg Foundation. I further tender my sincere thanks to the following persons who in various ways gave the Expedition valuable assistance towards its accomplishment, namely Vice-Admiral A. H. VEDEL, I. V. TEGNER, Captain in the Royal Navy, P. THOBO LARSEN, Commander in the Royal Navy, Professor, KNUD JESSEN, Ph. D. and Director for the Botanical Museum and Laboratory, Professor N. E. NÖRLUND, Ph.D., Director of the Geodetic Institute, Lt. Col. A. B. C. MADSEN, who died in Greenland in 1947, of The Geodetic Institute, The Director for the Administration of Greenland Mr. KNUD OLDENDOW, Captain EINAR MIKKELSEN, Inspector of East Greenland, Mr. F. SIMONY, Governor of Greenland, Mr. ERIK JUHL, Manager, and Mr. RIC. BÖGVAD, M. A., Ivigtut Cryolite Quarry, Lt. Col. L. N. NUTTAL, Chief Commander of the American Base in Söndre Strömfjord and Lt. TRUMAN F. HUME, of the same place.

It was a foregone conclusion that the investigation of the land vegetation was to be the chief subject. The Expedition therefore consisted of four specialists, a lichenologist, M. SKYtte CHRISTIANSEN, M. A., a bryologist, KJELD HOLMEN, M. A., a Mycologist, MORTEN LANGE, M. A., and myself who was to look after vascular plants, analysis of the vegetation, soil- and microclimatic examinations as well as undertake collections of fresh water algae. Of the four members of the Expedition MORTEN LANGE was put in charge of the provisioning.

The purposes of the Expedition might be summed up as follows:

- A) A floristic examination of the interior of West Greenland off Holsteinsborg combined with observations of the flora in the coast region in as many places as it was possible during the journey to and from the head of the Strömfjord. The flora was to be treated as universally as in any way possible, and the groups of non-vascular cryptogams to be collected by specialists, a thing which hitherto mainly had been done by L. KOLDERUP ROSENVINGE and S. LUND (marine algae) TH. FRIES, B. LYNGE and P. F. SCHOLANDER (lichens), and S. BERGGREN (bryophytes).
- B) An examination of the vegetation and the ecological conditions particularly in the interior of West Greenland. Special attention was to be paid to the continental plant associations at the margin of the ice cap. The examination of the vegetation was to a great extent to rest on the collaboration of the four members of the Expedition as the examination of the cryptogams in the various associations was to be carried out by the three specialists.
- C) Fixation of flower buds and collection of seed for a subsequent cultivation of as many Greenland-plants as possible. The purpose was investigations of chromosome numbers of a great part of the flora and cultivation experiments that might reveal important taxonomical, biological or genetic details.

2. Survey of the Expedition with an Account of the Localities Investigated.

The Expedition sailed on June 27th in the Naval Survey ship, "Heimdal", under the command of Commander P. THOBO LARSEN. The vessel reached Ivigtut in South Greenland on July 9th. On July 23rd the mouth of Söndre Strömfjord, and on the 25th the head of the Strömfjord were reached. The last part of the voyage from Godthaab took place in the Naval schooner, "Ternen", under command of Captain I. V. TEGNER. On August 31st the Expedition was fetched by the

naval schooner, "Maagen", under command of Lt. of the Navy, J. V. SANDER LARSEN, and was sailed to Godthaab from where the passage home took place in "Heimdal".

The ship stayed for a shorter time at Ivigtut on September 11—12 where SKYTTE CHRISTIANSEN, HOLMEN, and LANGE were landed and quartered in a guesthouse belonging to the Cryolite mine; thereafter I continued in "Heimdal" to Reykjavik and further on from there by liner to Copenhagen. Heimdal returned to Greenland and on October 1 fetched the three cryptogam-botanists who arrived in Copenhagen on October 12th.

The botanical working days were distributed on the following localities:

- 9—11 July: Ivigtut and Grönnedal in Arsuk Fjord, $61^{\circ}12'—14'$ n. lat.
- 13 July: Narssarssuaq at the head of Tunugdliarfik Fjord, $61^{\circ}11'$ n. lat.
- 15 July: Ivigtut, $61^{\circ}12'$ n. lat.
- 19—20 July: Godthaab and nearest vicinity, $64^{\circ}10'$ n. lat.
- 23 July: Pâ at the mouth of Söndre Strömfjord, $66^{\circ}00'$ n. lat.
- 24 July: Itivdlínguaq midway in Söndre Strömfjord, $66^{\circ}30'$ n. lat.
- 25 July—31 Aug.: The head of Söndre Strömfjord, $66^{\circ}50'—67^{\circ}00'$ n. lat.
- 1 Sept.: Kangâmiut south of the mouth of the Strömfjord, $65^{\circ}48'$ n. lat.
- 5—8 Sept.: Godthaab, $64^{\circ}10'$ n. lat.
- 11—12 Sept.: (for T. W. BÖCHER) Ivigtut, $61^{\circ}12'$ n. lat.
- 11 Sept.—1 Oct.: (for SKYTTE CHRISTIANSEN, HOLMEN, and LANGE) Ivigtut and Arsukfjord $61^{\circ}12'—14'$ n. lat.

a. The Söndre Strömfjord-Region.

Pâ and Itivdlínguaq.

A stay was made on July 23 on the way to the head of the Strömfjord just at the inlet into the fjord in the small cove called Pâ (fig. 1). Unfortunately it rained all day till about 4 p. m. Nevertheless a series of important investigations were carried out that together with the investigations at Kangâmiut (see p. 24) make a comparison possible with the continental parts of the country further inland. The vegetation at Pâ was of a marked maritime character with snow patches everywhere, in many places perennial snowdrifts near the surface of the sea, large luxuriant herb-fields, extensive *Empetrum*-heaths or *Empetrum-Betula nana*-heaths and open areas characterized by *Juncus trifidus*.

On July twentyfourth a stay was made in the region about Itivdlínguaq midway in the Strömfjord; Itivdlínguaq is a narrow extension of the fjord that continues into a valley, that leads over to the Itivdlefjord (fig. 2). Itivdlínguaq has a very beautiful and characteristic scenery. Only at a distance of about 60 km from the outer coast the climate



Fig. 1. The mouth of Söndre Strömfjord and in the midst of the picture the small cove, Pâ, that was examined on July 23. Skerries and coast rocks with alpine topography. Local glaciers and numerous perennial snowdrifts. Phot. July 1936 by the Geodetic Institute, (No. 24641). The Geodetic Institute, copyright.



Fig. 2. Itivdlínguaq, the valley between Söndre Strömfjord and the Itivdleq Fjord that is seen to the left in the middle of the picture. Behind the great lake in the valley the 1300 meter high Qáqatôrssuaq rises, the dry summit of which is almost quite without any connected vegetation. Rocks all with rounded forms. No glaciers or perennial snowdrifts. Phot. July 1936 by the Geodetic Institute (No. 24562). The Geodetic Institute, copyright.



Fig. 3. The wrecked truck immediately after the accident. The road was full of tins and more and less damaged boxes with equipment for the Expedition. T.W.B. phot. on July 25, 1946.

seems very continental. No snow was found except on the 9—1800 m high mountains south of the valley, and small local drifts were not seen at all, not even on the slopes facing north. All bore the stamp of drought. The difference from the locality the previous day and Itivdlínguaq was striking; the plants were new and the plant associations were new. The characteristic continental steppe-like associations were found in several places, and the great lake in the valley there was a *Dryas*-heath on a marked alkali soil with a pH-value over 9. Herbfield and genuine snow-patch vegetation had almost completely disappeared. The bag of that day was very large. The place ought no doubt to be examined again.

The Main Field of Investigation at the Head of Söndre Strömfjord.

On July 25th "Ternen" arrived at the Strömfjordshavn in the innermost northern arm of the Strömfjord. From here I drove in a truck together with Captain TEGNER to the main camp at the aerodrome to see the American Commander in Chief, Lt. col. L. N. NUTTAL, and look at the localities. It soon appeared that the main camp was best suited as a working basis. The commander of the camp then assigned



Fig. 4. The house of the Expedition at the American main camp at the head of Söndre Strömfjord. In front of the house M. Skytte Christiansen M.A. (to left) and Morten Lange M.A. (to right). Behind the house a steep rockside exposed to the south with steppe-vegetation ("Elyna-heaths", (i. e. *Kobresia myosuroides*-vegetation) and *Carex supina*-vegetation), seen as light surfaces and dry *Salix glauca*-scrub (dark spots). T.W.B. phot. on July 28, 1946.

to us a very well suited house and gave orders that our stores were to be carried to the main camp in trucks.

The road from the harbour to the main camp was 10 km long and had several dangerous curves and rather steep hills. On the way from the harbour a rather serious accident happened as the driver of one of the trucks that was going at high speed lost control of the truck; it turned upside down and slid towards the roadside with upturned wheels (fig. 3). On top of the truck several American soldiers were sitting and KJELD HOLMEN was with them flung into the road, and they received more or less serious injuries. One of the soldiers died the following day. HOLMEN had his shoulder and hand injured as well as some bad skin abrasions in the face. Later it appeared that he had broken a wristbone. He was treated for several days in the American hospital at the camp and after a week recovered enough to be able to botanize in the neighbourhood of the camp. He did not succeed in completely recovering during his stay in Söndre Strömfjord, but nevertheless he carried through some very important work and at last took part in several longer excursions.

A rather considerable part of the equipment of the Expedition had been destroyed or damaged in the accident. The Americans helped to

retrieve the damage by giving the Expedition some preserves and letting the members eat in the officers' mess during the first days.

The house that was given us was situated in a part of the camp that was not used at the time (fig. 4). It contained besides bedrooms a larger room that was fitted as dining room and laboratory. Here an oil-heated stove was put up which proved very useful for drying the material collected. The stove was constantly surrounded by plant presses and numerous larger sack-cloth bags with lichens and mosses packed in small paper bags. This made it unnecessary for us to change the pressing paper more than once. Besides the large room there were a bathroom and a kitchen. The windows were secured against the host of mosquitoes by netting. There was electric light and in the bathroom a stove that made it possible to secure hot water for washing up and baths. Besides the house a garage was placed at our disposal where all the stores and the bicycles were placed. We had taken the bicycles along at the instigation of Captain TEGNER, who had visited the camp in 1945; they proved very useful. Unfortunately one of them had been destroyed in the accident.

The situation of the house was extremely favourable. One road led towards the harbour; another followed the valley in the direction of the inland-ice ten km into the country; a third one crossed the valley to the great lake, Taserssuatsiaq, named by the Americans "Lake Ferguson" and from which the drinking water for the camp was fetched in big tankcars. The road stretches over an iron bridge that crosses a river abounding with water and which in this place rushes down through a small shallow canyon ("the lower rapids"). This river cannot otherwise be crossed without running any risks so the bridge was of great use to us as it extended our operation area to the large peninsula that separates the two inner arms of the fjord from each other.

Behind the house rose steep the mountain slope exposed towards south of Hassells Fjeld covered with a motley vegetation, partly consisting of various steppe associations, partly of dry willow-scrubs, partly of various dwarf-shrub-heaths. Through a smoothly sloping ravine taking a course parallel to that of the valley and beginning at about 250 meters' height the ridge of the steep side was easily reached; it was about 430 m above the sea, and from here the mountain rose smoothly to a height of c. 500 m above the sea. Behind the ridge a large alpine plateau stretched full of small lakes. Here was a rich possibility of studying the arctic-stamped plant associations of the area. No snowdrifts were observed anywhere here; and on the whole on all our excursions—also to the highest mountains 700 m above the sea—we saw absolutely no snow at all.

During much the greater part of our stay the weather was dry and warm. A temperature of 14—16° C. at noon was quite common. The

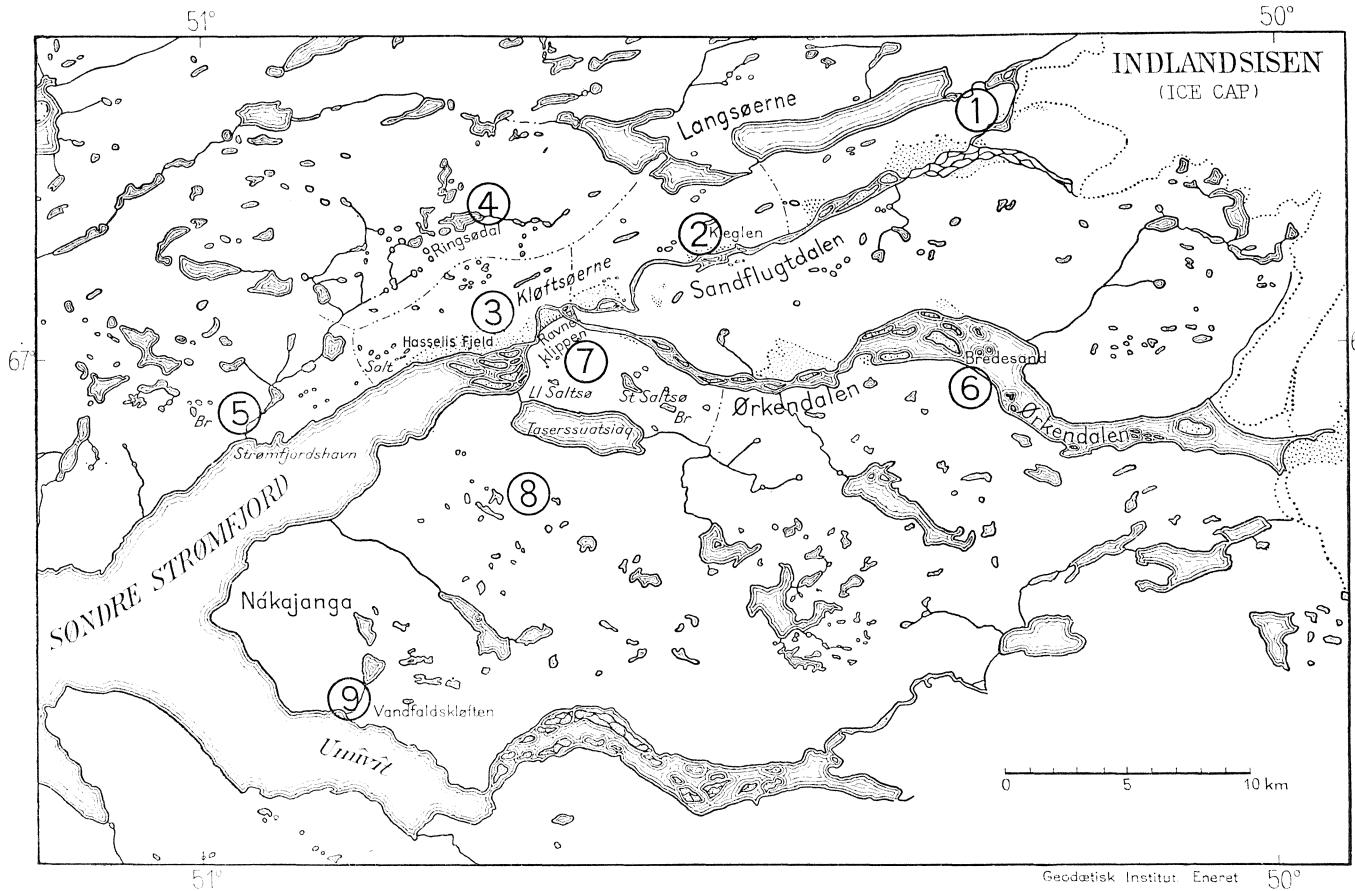


Fig. 5. A map giving a general view of the area about the head of Sondre Stromfjord. The Main Localities are indicated by figures. The boundaries between the Main Localities are indicated by — .. — .. — .. — .. Dots: Sandy dry areas (dune- and desert-areas) or sandbanks (in the riverbeds).

nights were cooler, often 5° or thereabout. Towards the end of August there was a couple of wet days and fresh snow appeared on the highest summits; but it thawed again. One thermograph was placed in the steppe-vegetation with southern exposure in the neighbourhood of the house. On clear days the temperature in the surface of the soil would rise to $40-50^{\circ}$ C.; while at nights it might be nearer 0° . Details about the temperature will be mentioned in a later work. (Vol. 147 No. 2).

In fig. 5 is a map showing a general view of the area round the head of Söndre Strömfjord, and fig. 9 shows an air photograph of the area that was most intensely investigated by the Expedition. For practical purposes the area is divided up into a series of numbered Main Localities of suitable sizes and with centres so far from each other that they may be dotted in maps of a smaller scale.

There are nine Main Localities:

- 1) The ice-border area at the end of Sandflugtdalen (the sand drift valley).
- 2) Sandflugtdalen in the region round "Keglen", a characteristic low mountain rising in the middle of the valley and resembling a sugarloaf.
- 3) The area at the main camp on the northern side of the river; Hassells Fjeld and the plateau north of the latter.
- 4) Ringsø Dal (the ring-lake valley) with nearest surroundings.
- 5) The region round Strömfjordshavn.
- 6) Bredesand; Ørkendalen (desert valley) at the widest part of the river plain.
- 7) The western part of Ørkendalen and the region south of it until the lake of Taserssuatsiaq.
- 8) The northeastern part of the Nákajanga-Peninsula.
- 9) The southwestern part of the Nákajanga-Peninsula at Vandfalds-klöften (the waterfall ravine).

During our stay at the head of Söndre Strömfjord some days were used for smaller excursions in the immediate vicinity (Loc. 3 and 7), and for classification of the material collected. In between the latter less exhausting days longer excursions were made into the region. Some of the said excursions should be mentioned. They yield a good survey of the area and deal with some of the most interesting places.

August 13th—15th. Excursion through the valley, Ørkendalen, and to Store Saltsø (the large saltlake) (Loc. 6—7). According to the original plan it was our intention by this route to penetrate to the ice-edge and try to reach onto the Isordlerssuaq-Nunataks described by J. A. D. JENSEN. We were, however, soon obliged to give up our plan among other reasons because the territory in Ørkendalen was rather difficult, and some of us were badly exhausted. During the first part of the ex-



Fig. 6. The western part of Ørkendalen (the Desert Valley) in direction towards the inland-ice that is to be distinguished in the background. MORTEN LANGE phot. on Aug. 13, 1946.

cursion we walked on a slope facing north, in some places rather steep and covered with *Betula nana*-*Ledum decumbens*-*Aulacomnium turgidum*-heath (Fig. 6). This type of vegetation with its rather high dwarf shrubs and deep soft moss-cushions is just as difficult to walk in as it is easy to walk on the steppe-vegetation on the mountain sides facing south. We hoped to be able to get along quickly by walking in the plane broad river bed, but this only proved possible in very few places because the river bed either was flooded, or in the dry parts was full of treacherous quicksand areas that in several places threatened to cut us off from reaching the bank again. We learned here to make use of the caribou tracks. Where fresh tracks were found in the river bed it was safe to proceed; when the tracks turned towards the bank it was the best plan to follow suit. Owing to the said difficulties we only reached along 20 km on the first day. The last piece was very interesting. Nature here reminded of a desert landscape; the river bed was about two km wide and dry and firm at the bank, and we were able to walk quickly. In the evening we made up our camp under a steep rock facing north and sought in vain for water for some time. All brooks were completely dried up, and it was not easy to get to the river water on account of the

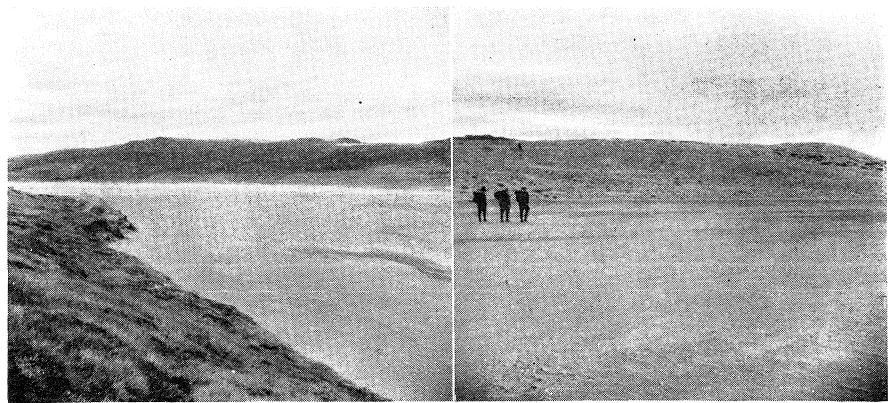


Fig. 7.

Fig. 8.

Fig. 7. View over the widest part of the sand flat in Ørkendalen (Loc. 6.) MORTEN LANGE phot. on Aug. 14, 1946.

Fig. 8. The broad sand flat and a smaller desert-like area in Ørkendalen, MORTEN LANGE phot. Aug. 14, 1946.

quicksands. The easiest thing was therefore to dig a hole in the dry part of the sand flat in the bed. There so much water gathered as was needed. Wherever we rested, or had a meal, innumerable hosts of mosquitoes and flies descended on us. In order to be left in peace during meals it proved a good idea to light fires. It was always easy to find dead willow trunks for that purpose. In the night the wind rose. The next morning it grew stronger and whirled up the uppermost dry sand-layer of the valley. The clouds seemed to be gathering for rain. These unfortunate weather-conditions essentially contributed to an alteration in our plans, and we concentrated on the remarkable desert-like area we had reached. From the heath-covered rockside facing north we had a magnificent view over the valley. The east wind carried the sand out over the valley and deposited it partly on a large desert-like rocky area on the northern bank (dotted on fig. 5), partly on a smaller area on the southern bank. The latter (fig. 8) was more closely examined. It bore the stamp of rather violent winds from east. On the slope down towards the flat the erosion was of course particularly bad. The bottom was gravelly and bare, as all the sand blew off it; only behind larger boulders long sand-hills were deposited colonized by *Dryas integrifolia* and *Carex nardina*. On the topmost less steep part of the slope began a deposit area with dunes particularly formed by *Salix glauca*. In the hollows among the dune walls there was on dryer ground a colonization of *Chamaenerium latifolium* and *Rumex acetosella*, on moister ground of *Equisetum arvense* or *Carex incurva*. Farther to west where there was more and more shelter the dunes were levelled out and at the same time

the *Salix*-areas united into a dense, rather low willow vegetation exposed to moderate sand deposits.

On the way home the same route was at first followed. A camp where to spend the night was made near a small lake in the valley about 12 km from the base shortly before the first rain for a long time began falling. The rain continued most of the night and in the early hours of the morning. In the morning of August 15th, we made our way up to a pass in the mountain side facing north. The pass leads to a basin with a small lake lying about 300 m above sealevel. This lake has at springtime outlet towards south to lake Taserssuatsiaq through a small ravine in the rocks. There cannot be much of an outlet as below the ravine there is no trace of a bed in the southturned mountainside. During our stay the lake had no outlet; the waterlevel was sunk about $\frac{1}{2}$ m under threshold height of the ravine, and the lake received no water from the surrounding terrain. The water was drinkable but tasted slightly salt, and pH was measured to about 8. Evidently the vegetation was transitional between the usual lake vegetation with neutral or moderately acid water, and the vegetation of the more saline lakes. On the bank there was an abundance of *Saxifraga aizoides*, *Pinguicula vulgaris*, *Primula stricta*, and *Puccinellia deschampsoides*.

From this smaller lake (Br in fig. 5, a—a in fig. 9) a valley leads in westerly direction into a larger potformed basin. To begin with the ground in the valley rises to a threshold that prevents the water from the smaller lake to flow down into the larger basin. Then the ground smoothly sinks towards west. It is difficult to judge how many meters, but it is at least a matter of 50 meters before one faces the next water-level at the bottom of the larger basin. The lake thus reached is a little over 1 km long and about 600 m wide in the widest place (see fig. 5 and b—b in fig. 9). The water tastes salt and is almost undrinkable. pH of the water reaches 9. There is no vegetation in the lake beyond a poor plankton flora. Round the lake there are four terraces which shows that the waterheight gradually has declined. In the western end of the lake the terraces consist of large red moss deposits. The moss (*Drepanocladus aduncus*) is mixed with loess that partly forms layers alternating with purer layers of moss, partly fills the numerous crevices in the mossy terraces. In the crevices there are plenty of *Braya linearis*, *Primula stricta*, and *Gentiana detonsa*, and several other rare plants. I had already begun a closer examination of this "Store Saltso" and its banks on an excursion on August 8th. Now all four members were engaged in the investigations that led to a series of very interesting findings. A detailed account will appear in later papers. We left the lake in the afternoon and followed a valley in westerly direction. Here the territory to begin with rises to a threshold that lies high over the surface of the

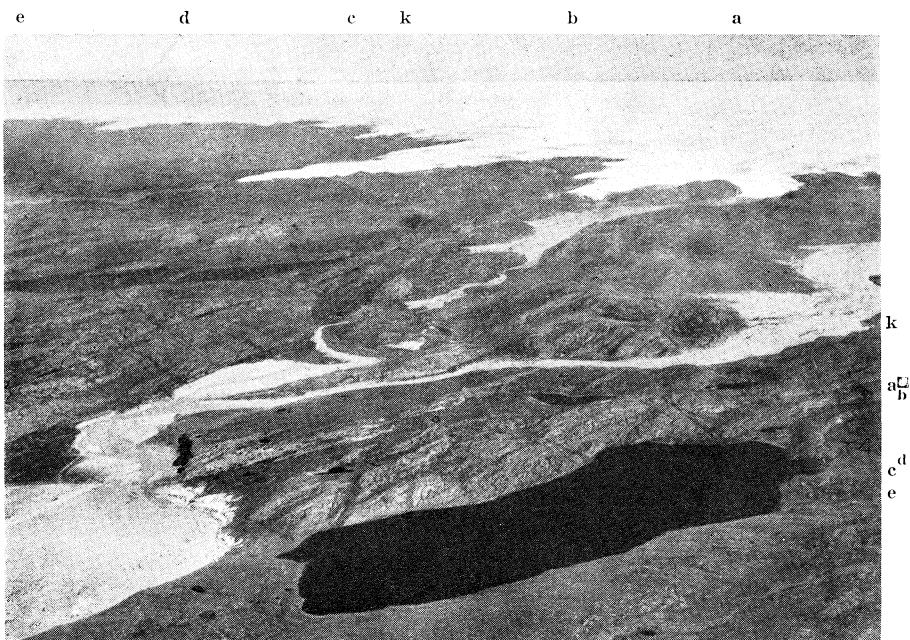


Fig. 9. View over most of the ice-edge area at the head of the northern arm of the Søndre Strømfjord. In the foreground lake Taserssuatsiaq; behind the latter Ørkendalen that to the right begins to extend to the large sand plain at Loc. 6 (that lies outside the picture). Sandflugtdalen is seen behind Ørkendalen as a diagonal in the picture. a—a Lake with slightly salt water mentioned on p. 45, b—b Store Saltsø, c—c Lille Saltsø, d—d Ravneklippen, e—e Locality 3, the place where the American main camp is now situated, k—k Keglen. Phot. July 1936 by the Geodetic Institute (No. 24181). The Geodetic Institute, copyright.

lake, and from here it slopes down to the innermost cove of the northern arm of Søndre Strømfjord. South of the valley in a deepening there is a lake which we called "Lille Saltsø" (see figs. 5 and 9 c—c). It was not nearly as salt as the large lake. It was examined on several excursions from the main camp and its banks appeared i. a. to give shelter to the very rare *Ranunculus cymbalaria*, a somewhat halophilous species that is most frequently found at sea-shores.

August 21th. Excursion to the south of the Nákajanga-Peninsula at the Vandfaldskloften (Loc. 9). On this excursion we used a motor boat with a Greenland crew, kindly placed at our disposal by the Geodetic Institute base-line surveyors. From the studies in the herbarium we knew ERLANSON's finding of *Orchis rotundifolia* from the bank of a river in Umívit, the southern arm of the Strømfjord. It could scarcely be the great river that has its outlet in the innermost part of the fjord. The big rivers in the region are namely surrounded by gravelly, stony, or sandy banks that have no continuous vegetation. We there set our course for



Fig. 10. View over Nákajanga, the plateau of which reaches a height of 690 m above sealevel. In the background the northern arm of the Strömfjord. In the foreground in the middle of the picture Vandfaldsklöften. The uniform light shade on the southern mountainside is due to dry *Carex-supina* steppe-vegetations; the dark shade at the bottom of the slope and the east slope towards the two mountain lakes are various dwarf-shrub-heaths. Phot. July 1936 by the Geodetic Institute (No. 23700). The Geodetic Institute, copyright.

a place where a small river runs down the steep mountain side facing south. The river drains some mountain lakes on the plateau of the Nákajanga-Peninsula. Outside the mouth of the river the fjord is rather shallow, and the bottom consists of soft mud. In spite of our warnings the Greenlanders ran the boat aground, and we were then placed in a narrow Portuguese dory and sculled in to the shore. Luckily the boat came afloat in the course of the day. The locality appeared to be very rich and at the same time extremely interesting. It contained a vascular plant flora of up to 100 species, among which were *Arabis Holboellii* and the very rare *Orchis rotundifolia*. We had no doubt found ERLANSON's original place. The *Rhododendron*-heath in which *Orchis rotundifolia* grew was scarcely anywhere so beautifully developed as here, and it was evidently the rare combination of exposure to the south and running water that was the cause of the appearance of the species here. Round the river there were besides the luxuriant *Rhododendron*- or *Rhododendron-Dryas* heath willow-copse of a man's height with herb and moss strata more marked by moisture than usually in the region. A few steps in both directions away from the small river was the *Carex supina*-steppe that is characteristic of the sunny sides of the region and which here extended over very considerable expanses (see fig. 10).

Continuing along the river higher up you pass a beautiful waterfall and through a small crevice come up to the first of the two larger lakes on the mountain plateau. As soon as the edge of the plateau is reached the vegetation completely changes in character. Dwarfshrub-heaths, and among them *Cassiope tetragona*-heaths, play the main part, and the flora becomes alpine with a large contingent of arctic species, which are not found in the lowland.

August 1st and 10th. The Northeastern Part of the Nákajanga-Peninsula (Loc. 8). From Taserssuatsiaq the territory slopes smoothly upwards to heights of 6—700 m above the sea. Much the greater part of this slope facing north is covered by luxuriant dwarfshrub-heaths, where one's foot with every step sinks deep down in dense moss, especially *Aulacomnium turgidum*. At about 250 meters' height above the sea *Cassiope tetragona* is noticed and indicates places with relatively long snowcovering, but it only plays a larger part above the 500 meter curve. The characteristic yellowy puffy lichen, *Dufourea arctica*, generally appears together with *Cassiope* and is not at all found in the lowland. Genuine snow-patch vegetation is also completely missing here. During the ascent *Salix herbacea* only began to appear on damp, very steep, surfaces at 400 meters' height, but then it became more and more frequent on the way up. On the plateau on top it was very frequent, but distinctly selective and not by far of the same importance as in the lowland in the coastal regions, not to mention East Greenland at a corresponding latitude. The most important vegetation on the plateau was besides the *Dryas*-fell field, an alpine heath rich in lichens, and dominated by *Vaccinium uliginosum microphyllum* and *Diapensia lapponica*.

The plateau is full of lakelets. While such small lakes behind Hassells Fjeld (Loc. 3) which lie on a mountain plateau at about 400 meters' height are rich in vegetation (i. a. southern species like *Menyanthes trifoliata*), the lakes on the Nákajanga plateau are almost devoid of aquatic plants. The water is clear and certainly oligotrophic and has a pH of 7 or thereabout. Round the lakes there are in many places wet patches with *Tofieldia minima* and *Pinguicula vulgaris* or *Saxifraga aizoides* and *Juncus castaneus*; moving soil rings with open vegetation of *Saxifraga oppositifolia* and *Silene acaulis* occur locally. In the lowland practically no moving soil phenomena are observed except on certain steep slopes facing north.

On the first of the excursions the edge of the mountain-plateau was followed some kilometres in the direction of the northern arm of the Strömfjord. Here was a rock exposed to south in front of which a scree had formed. Nearest the rock there was a low willow vegetation rich



Fig. 11. Ringsø Dal seen in direction towards northeast. Three of the lakes are seen and between them two narrow strips of land surrounded by low walls. To the right is a slope to northwest with tufted *Betula nana*-*Ledum decumbens*-heath, on flat land nearest the mountain *Betula nana*-*Aulacomnium turgidum*-Soc with abundant *Calamagrostis hyperborea*, to the left mossy *Calamagrostis*- or *Eriophorum Scheuchzeri*-sociations on very wet ground behind wall with *Salix*. T.W.B. phot.

Aug. 24, 1946.

in herbs with species like *Polygonum viviparum*, *Cerastium alpinum* and *Taraxacum* cfr. *croceum*, several *Saxifraga*- and *Draba*-species, *Arnica alpina*, *Cystopteris fragilis* and others. At the head of the Strömfjord this was the only spot I saw that reminded of a herbfield. It was interesting to note that the vegetation in this place was alpine. Only at 5—600 metres height it is possible to find a combination of a relatively short but presumably rather constant snow-cover in the winter, south exposure and sufficient humidity of the soil during the vegetation period.

August 17th and 24th. Ringsø Dal (The Ring-Lake Valley) (Loc. 4). From the highest places on the mountain plateau north of Hassells Fjeld we could see a series of lakes separated by narrow strips of land. The valley in which the lakes were situated was twice visited by me, and once by MORTEN LANGE and KJELD HOLMEN. Some of the lakes were circular and surrounded by a low sandy wall. We therefore called the valley by the name of Ringsø Dal. The scenery in this valley is completely different from that of the large river valleys. This is in the first instance due to the fact that the bottom of the valley lies higher in the Ringsø Dal, secondly that this valley had no rapid river flowing through it forming sandy plains surrounded by areas of dunes. Thirdly there is more shelter for the east wind, which characterizes the large open river valleys reaching up to the edge of the inland-ice.



Fig. 12. View over Ringsø Dal in direction towards west. On the steep mountain side facing north in the foreground to left mossy *Cassiope tetragona*-heath. Below *Betula nana*-*Ledum decumbens*-heath. MORTEN LANGE phot. Aug. 1946.

Figs. 11 and 12 show the Ringsødal seen from east and west. The lakes look very much as if they had arisen after the melting of dead ice. Very remarkable is the low wall surrounding so many of them. The walls look like narrow ramparts and are one or at most two metres high. They consist of sand and are covered particularly by willows and dwarf-birch. The territory lying behind the walls is very low, at most some centimeters raised over the surfaces of the lakes. An *Eriophorum*-*Carex rotundata*- or *Salix arctophila*-vegetation rich in bryophytes is found here, or, in the drier level, a *Calamagrostis*-meadow. There is little connection between the lakes. On my visit no water was flowing from lake to lake. The waterlevel was low, and a narrow sandbeach was laid bare. The lakes may perhaps in extremely dry-weather periods dry up so much that there is a wider sandbeach with dry sand. The sand may then with the wind be carried up on the bank where it will gather under the *Salix*-bushes. In this way the bank will gradually grow higher and the wall be formed. This view is supported by the fact that the walls at any rate in some places were particularly high at the western end of the lakes. Here erosion, however, often took place so that there was a more or less naked sandslope facing the lake (fig. 13). BELKNAP



Fig. 13. The west end of one of the circular lakes in Ringsø Dal. In the foreground willow-copse on the bank and beginning wall-formation. Farther back distinct wall with erosion slope; to the right wet *Calamagrostis* vegetation. T.W.B. phot. Aug. 1946.

(1941) describes similar "ice ramparts" in the western ends of some other lakes and he assumes that the walls are formed by lake ice which is melted and broken up by föhn-storms and then driven by the wind to the west shore, where it forces the material up into a rampart around the edge of the lake. I examined two of the narrow strips of land that separated three lakes lying in a line. One was in the narrowest place only a few meters wide. Its eastern bank sloped smoothly down into a lake with a sand bottom without any vegetation, towards west it rose slowly to a 1—1.5 m high wall that with a steep slope descended into the lake lying west of it that was here c. 1—1.5 m deep. A profile transect across the narrow landstrip had the following narrow belts:

- 1) Flat, moist sandbeach with *Juncus arcticus*; stripe of foam.
- 2) Desiccated sandbeach with *Primula stricta*.
- 3) Heathlike vegetation of *Betula nana*, *Rhododendron lapponicum*, *Salix arctophila*, *Ledum decumbens*, *Tofieldia minima*, and *Chamaenerium latifolium*.

- 4) At the top of the wall: *Betula nana*—*Salix glauca*-scrub with a field stratum of *Vaccinium vitis idaea* ssp. *minus*.
- 5) Lake vegetation of *Hippurus vulgaris* and *Potamogeton gramineus*.

In a single place the wall was broken through and by high tide water might wash over from one lake to the other. There was no passage through the other strip of land. It was all over covered with vegetation and there were walls on both sides. Only one wall was intersected in one place by a narrow crevice so that water that gathered inside the walls in this way could reach one of the lakes. Such a thing might evidently happen at rare times for a small sandbank had gathered outside the narrow crevice.

In the middle of the valley is a two kilometer long lake (fig. 12), and from here the territory rises towards east up to some small lakes. All the said lakes are connected mutually and with the larger lake by small brooks or waterlanes that are most often completely hidden by a 2—3 m high willow copse. In and at the said waterlanes there are beautiful growths of angelicas as tall as a man (*Angelica archangelica*). Also at similar brooks farther to west in the valley system there were angelicas and uncommonly luxuriant willow scrubs. It was clear that the rare occurrence of the angelica in the region was connected with the fact that most small rivulets dried up later in the summer. In the Ringsø Dal all the rivulets looked as if they were permanently aqueous.

August 19th and 26th. The Eastern Part of Sandflugtdalen and the Ice-margin (Loc. 1). On account of the road that was built from Loc. 3 to "Keglen" (Loc. 2) it was easy to get over the first piece in direction of the ice-margin. Here we made use of the bicycles. Farther east it is easier first to go through a valley north of Keglen, a valley that ends in the inner part of Sandflugtdalen. The valley north of Keglen is full of heaths, low scrubs of willow or dwarf-birch, *Elyna*-heaths, (i. e. vegetation dominated by *Kobresia myosuroides*), grassy meadows with great quantities of *Ranunculus affinis*, and small lakes at the banks of which there was any number of *Lomatogonium rotatum* in white and blue-flowered varieties. When this part of the road is left behind the remainder of the tour to the ice-margin is easy. Most of the way passes over a relatively firm sand flat that in some places is covered with scattered tufts of *Dryas integrifolia*, *Carex nardina*, and patches of *Chamaenerium latifolium*. At the western edge of the flat there are several interesting dune-areas and lakes with sandy banks. There are only small windblown areas with gravelly, stony ground. A few kilometers from the ice-margin one turns away from the main valley towards north-east into a narrower side valley with a rapid glacier-fed river. The entrance to the side valley is blocked by a large dune or sand hill, from



Fig. 14. Small side valley to Sandflugtdalen blocked by large dune without any vegetation. In the foreground low dunes with a vegetation of *Salix glauca*. In the background the ice cap. T.W.B. phot. Aug. 26, 1946.

which the sand slides down into the river (fig. 14). The large dune reminded me of the hills named "Staldbakkerne" on the Randbøl heath in Jutland, that according to V. MILTHERS (1925) are late glacial dune-formations that have been formed close to the inland-ice. We followed the ice-margin for a while and were able to ascertain that the closeness of the ice was of no importance for the fertility or expanse of the vegetation. The vegetation reached quite up to moraines or riverbeds. Thus in this place there seemed to be no sign that the ice-border was retiring towards east. The plant associations were the same as at the head of the Strømfjord. Fig. 15 shows the margin of the ice cap, and in front of it a sunny side dominated at the top by steppe with *Carex supina* and *Calamagrostis arundinacea* var. *purpurascens* and at the bottom on slightly moister ground *Salix glauca* scrub. The shadowy side was dominated by *Betula nana*—(*Vaccinium uliginosum*)—*Aulacomnium turgidum*-heath and the flat territory in the middle of the picture is a fen dominated by *Calamagrostis Langsdorffii*. In other places there were beautifully developed *Elyna*-heaths among low dry willow- or dwarf-birch scrubs, and in one place there were dunes overgrown with lyme-grass (*Elymus arenarius*). On the slopes exposed to the north there

were as usual particularly steep shadowy places with *Cassiope tetragona*-heaths and in several places a non-typic rudimentary snow-patch-vegetation in the shape of mossy patches with *Saxifraga cernua*, *nivalis* and *groenlandica*. On August the 26th we measured the temperature 10—20 m from the ice-wall that is seen in fig. 15. It was a day of clear sunshine and rather light east winds and the temperature at breast-height was at 12 o'clock 8° C. A little farther away from the ice-edge there was the same temperature, or perhaps it was a little warmer, and at the head of the Strömfjord 10° were measured at the same time.

Animal life at the Ice-margin. The animal life was particularly rich in the neighbourhood of the ice-cap. Both in Loc. 6 and 1 we saw caribou, and at Loc. 1, 2, and 3 several snowshoes were observed. In Loc. 1 they were so tame that one could approach them till about 15 m's distance, and they did not stir. At the ice-margin I witnessed an interesting fight between an eagle and a peregrine falcon. The falcon attacked the eagle like a diving fighter attacks a heavy bomber; each time it was quite close to the eagle the latter suddenly rose and tried to hit it with its beak, but the falcon got away every time. At one time the falcon disappeared from our view but a raven took its place, and it also seemed to get the better of the larger enemy. In the whole region at the head of the Strömfjord there were a great many geese and also many grouse. That there were so few caribous was no doubt owing to the fact that the Greenlanders had been too eagerly shooting the latter animal. Everywhere we saw the lichen-grown horns from the large stocks of former days. One ought to try—perhaps only for a series of 20 years—completely to preserve the caribou at the head of Söndre Strömfjord, so that once more they might have an opportunity of propagating. The very considerable production of matter furnished by the close, vigorous vegetation in the very wide country before the inland-ice ought certainly to benefit the population of Greenland, and this is no doubt most easily done by encouraging the stock of caribous.

b. Kangâmiut, Godthaab and South Greenland.

Kangâmiut. On the way home on September 1st, we made a halt of 24 hours at Kangâmiut, that lies on a small island south of the mouth of the Strömfjord. Kangâmiut has a very exposed position. The climate is windy and moist. The vegetation is marked by the large quantities of snow that fall in the winter, particularly after Christmas, and lie till into the months of May or June. Everywhere were *Salix herbacea* snow-patches in many variations, besides large patches of *Sibbaldia procumbens*- and *Alchemilla alpina*-vegetation as well as heaths with *Phyl-*

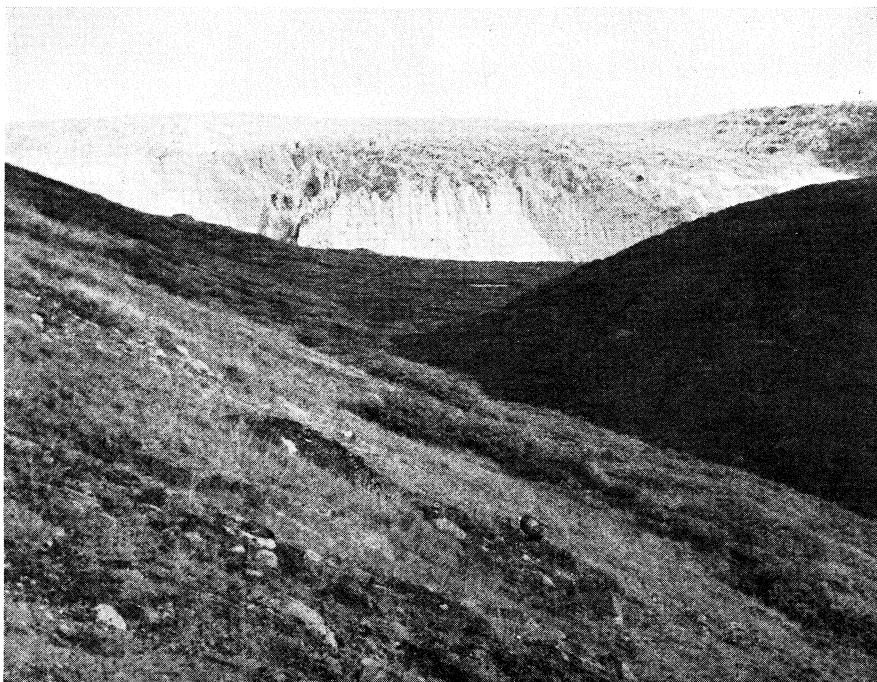


Fig. 15. The border of the inland-ice in the territory behind Sandflugtdalen. In the foreground a sunny side with steppe vegetation. Just in front of the ice-cap there is a narrow valley through which a river is running. The ice-margin is breaking up, and large ice-floes fall down into the river, where they melt. T.W.B. phot. on August 26, 1946.

lodoce coerulea as a dominant or important component. On the tops of the rocks that at times are swept snow-bare by the wind occurred *Rhacomitrium hypnoides*-heaths with a wealth of the pretty little *Minuartia groenlandica* and *Empetrum*-heaths, or patches with *Loiseleuria procumbens* and *Diapensia lapponica*.

Godthaab. Both on the way out and on the way home the Expedition had a 5—6 days' stay at Godthaab. Most of the time here passed with the reloading of the stores. On the six botanical working-days a series of excursions was made into the surroundings of the colony. The longest excursion (July 20th) went to the mountains, Lille and Store Malene. At Godthaab a rather comprehensive material of vegetation-analyses were collected that greatly supplement the observations from the mouth of the Strömfjord, whose vegetation does not deviate from that of the Godthaab region on any essential point.

Ivigtut and Arsuk Fjord. Also this region was examined on excursions both on the journey out and home (cf. p. 6). HOLMEN, LANGE, and

SKYTTE CHRISTIANSEN spent 25 days here, while I myself only stayed there for six. Ivigtut with surrounding country is excellently suited for comparisons with the head of the Strömfjord. The two regions are alike with regard to summer heat, but complete contradistinctions as regards humidity-conditions. At Ivigtut we have the highest known precipitation in Greenland, and at the head of the Strömfjord the lowest known. While the vascular plant flora at Ivigtut is well known from the work of several earlier expeditions the same does not apply to mosses, lichens and fungi. It was therefore an extremely good thing that the three cryptogamologists had an opportunity of really undertaking thorough-going studies in the vicinity, and it was a great help that the house in which they lived easily was transformed into a laboratory. From Ivigtut several excursions were made, i. a. to Grønnedal farther along in the fjord and to a locality just opposite on the north side of the fjord.

Narssarssuaq. The surroundings at the large aerodrome at the head of the Tunugdliarfik Fjord were visited on July 13th. A very great number of collections was made. The most remarkable finding was *Selaginella rupestris*, which had not previously been observed in Greenland. (See BÖCHER 1948).

3. A Survey of the Collections made by the Expedition.

The following articles in vols. 147 and 148 of *Meddelelser om Grønland* will deal with the elaboration of the material collected during the Expedition. It consists of the following categories:

A. Systematic Collection.

All collections of plants belong to the Botanical Museum in Copenhagen. In many cases the individual collections are so large that they may be divided and sent out as duplicates to other Botanical Museums.

Pteridophytes and flowering plants are collected by and dealt with by the present writer. There are about 1200 collections.

The bryophytes are collected by KJELD HOLMEN M. A., in all about 1400 collections. HOLMEN himself deals with the main part; the genus *Sphagnum* is determined by BODIL LANGE, M. A., and the livermosses by EVA CLAUSEN, M. A.

The lichens are collected and determined by M. SKYTTE CHRISTIANSEN, M. A. In all there are about 5000 collections.

Macro-mycetes are collected by MORTEN LANGE, M. A. who also himself determines them. There are in all 700 collections. A paper dealing with the *Gasteromycetes* (LANGE 1948) has already been published. Besides a great number of fungi are determined and described immediately after the collection in Greenland where at the head of the Strömfjord as well as at Ivigtut there was ample opportunity for microscopy.

Micromycetes; only few collections were made of some of the most conspicuous and characteristic species.

Fresh Water Algae and Fresh Water Plankton. In all 50 samples were collected and preserved in alcohol or formol. A part of the collection was made with a view to examination of the Desmidiacé-flora and has been handed over to the Finnish expert Dr. ROLF GRÖNBLAD; other samples have not been handed over to any definite person. The plankton samples from some of the lakes, among them Store and Lille Saltso, have kindly been taken over by Dr. GUNNAR NYGAARD. A paper on some interesting algae from a pool at Ivigtut has already been finished (BÖCHER 1950).

Microscopic Animals living in the soil and among the mosses were collected in a series of selected plant associations. The material will be dealt with by MARIE HAMMER, Ph. D. The Tardigradfauna in a series of moss samples collected by KJELD HOLMEN, M. A. is being determined by BØRGE PETERSEN, B. A.

B. Ecologic Material.

Vegetation-Analyses. A great many vegetation-analyses were undertaken (examinations of the degree of covering; square size: as a rule 1 square meter). I myself undertook 320 analyses intended for an illustration of the ecology of vascular plants and the vegetation as a whole. The mosses and the lichens from the said analyses were in the case of the more difficult species examined by HOLMEN and SKYTTE CHRISTIANSEN. For the illustration of the occurrence of the mosses HOLMEN himself undertook 84 analyses, and for the examination of the ecology of the lichens SKYTTE CHRISTIANSEN undertook further 60 analyses. MORTEN LANGE examined 110 permanent squares, where he at certain intervals followed the development of the higher fungi during the time that was spent at the main camp in the Strömfjord.

Soil analyses. 125 samples of soil were collected from various plant associations. Some of the samples were larger and permitted more thorough examinations. The analysing work was kindly done by Statens Planteavls Laboratorium (the State Laboratory of Plant Culture); some more detailed analyses of saline soils were kindly undertaken by Professor F. STEENBJERG, Agr. D.

Water samples. In the various lake-types at the head of the Strömfjord a smaller number of water samples were collected. The latter as well as some samples of salt crusts have kindly been examined at the Chemical Laboratory of "Danmark's Geologiske Undersøgelser" (Geological Survey of Denmark) by the state-geologist WERNER CHRISTENSEN.

Microclimatic observations in three different places in the days from July 30 to Aug. 30. The temperature in the surface of the soils was examined by means of three selfregistering distance thermographs.

A treatment of the climatic observations and the material of soil and water samples is found in BÖCHER 1949.

C. Cytologic Material and Material for Cultivation Purposes.

During the Expedition a smaller number of fixations (c. 30) was undertaken particularly of flower buds. 65 species of vascular plants were collected and reached Denmark alive. Further 110 samples of seed were collected. Both the living plants that were brought home and the many plants that in 1947 have germinated from the seed were used later for fixations of root-tips and flower buds. The chromosome numbers are determined by myself assisted by KAJ KARSEN, B. A.

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